DESCRIPTION

FUSED BICYCLIC PYRIDINE DERIVATIVE AS TACHYKININ RECEPTOR ANTAGONIST

TECHNICAL FIELD

The present invention relates to novel fused bicyclic pyridine derivatives and pharmaceutically acceptable salts thereof that act as tachykinin receptor antagonists. The present invention also relates to medical applications of such compounds.

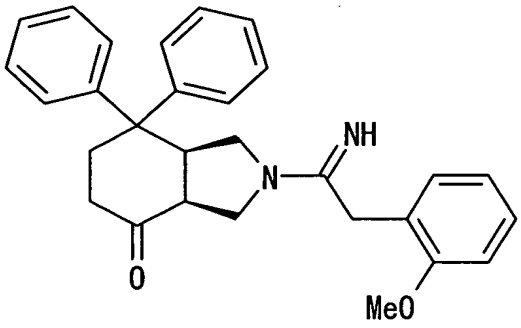
TECHNICAL BACKGROUND

'Tachykinin' is a collective term for such neuropeptides as substance P, neurokinin A, and neurokinin B. These tachykinins are known to exhibit various physiological activities by binding to corresponding receptors in a human body (neurokinin 1 (NK1), neurokinin 2 (NK2), and neurokinin 3 (NK3), respectively). Of different tachykinins, substance P, aside from its role as a neurotransmitter in primary sensory neurons in central and peripheral nervous systems, brings about various physiological effects, such as diuresis, excitation of neurons, increased blood vessel permeability, blood vessel dilation, contraction of smooth muscles, and immune activities. Substance P is also believed to play

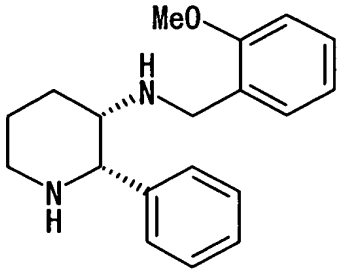
significant roles in the onset of various pathological conditions such as pollakiuria, incontinence, vomiting, inflammation, allergies, respiratory tract disorders, pains, and central nervous system disorders. Thus, a need exists for the development of a compound that acts as a tachykinin receptor antagonist and, in particular, as an NK1 receptor antagonist and is thus suitable for use as an effective prophylactic or therapeutic agent against various pathological conditions such as those mentioned above. It is also desirable that such a compound offers high safety, persistence of efficacy, and other advantageous characteristics.

At present, the following compounds are known as NK1 receptor antagonists and are described in the following publications:

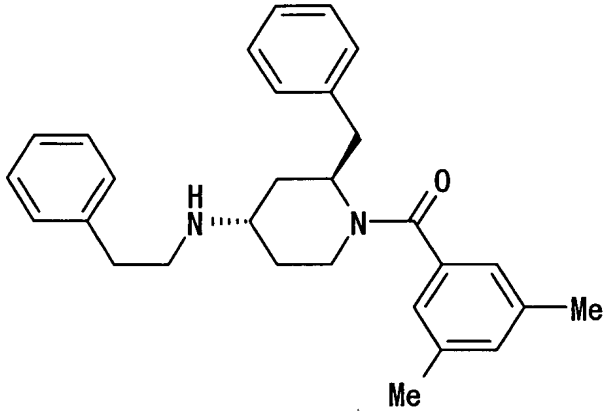
(1) European Patent Application Publication No. EP-A-429366 describes compounds such as the one represented by the following formula:



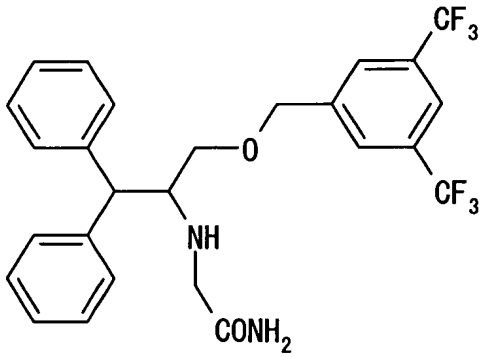
(2) PCT pamphlet (International Patent Publication) No. WO91/09844 describes compounds such as the one represented by the following formula:



(3) European Patent Application Publication No. EP-A-532456 describes compounds such as the one represented by the following formula:

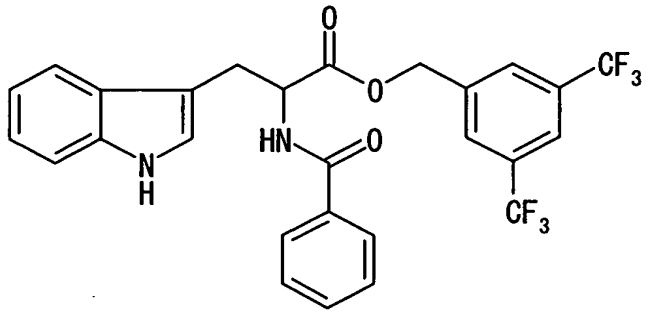


(4) European Patent Application Publication No. EP-A-522808 describes compounds such as the one represented by the following formula:

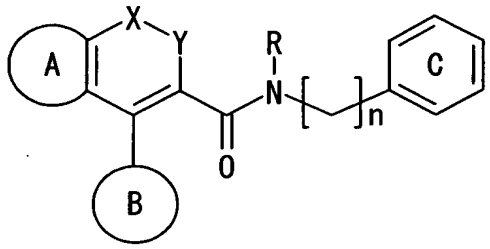


(5) PCT pamphlet (International Patent Publication) No.

WO93/01169 describes compounds such as the one represented by the following formula:

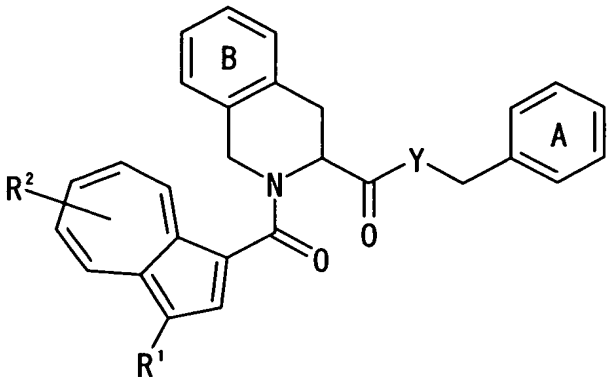


(6) Japanese Patent Laid-Open Publication No. Hei 8-67678 describes a compound represented by the following formula and salts thereof:



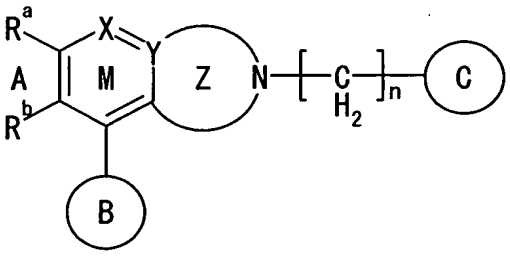
wherein the rings A and B are each a homocyclic or heterocyclic ring with at least one of the rings A and B being a heterocyclic ring; the ring C is a benzene ring; R is H or a hydrocarbon residue; one of X and Y is $-NR^1-$ (where R^1 is H or a hydrocarbon residue) or -O- and the other is -CO- or -CS-, or one of X and Y is -N= and the other is $=CR^2-$ (where R^2 is H, a halogen, a hydrocarbon residue, an amino, or a hydroxyl group); and n is 1 or 2.

(7) Japanese Patent Laid-Open Publication No. Hei 9-104674 describes a compound represented by the following formula:



wherein Y is a nitrogen or oxygen atom which may or may not be alkylated or acylated; R^1 is a hydrogen atom, a lower alkyl group, a lower alkanoyl group, an alkyl group having a nitrogen atom, a carbamoyl group, a lower alkylthio group, a lower alkylsulfinyl group, a lower alkylsulfonyl group, or a (4-phenylpiperadine-1-yl)methyl group; R^2 is a hydrogen atom, a lower alkyl group, a lower alkyl group having a hydroxyl group, a lower alkanoyl group, or a lower alkoxy group; and the rings A and B are each a substituted or unsubstituted benzene ring.

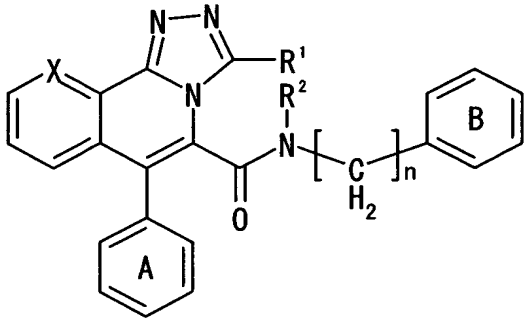
(8) Japanese Patent Laid-Open Publication No. Hei 9-263587 describes a compound represented by the following formula:



wherein the ring M is a heterocyclic ring in which the structural moiety -X=Y< is -N=C<, -CO-N<, or -CS-N<; R^a and R^b may together form the ring A, or R^a and R^b are each independently a hydrogen atom or a substituent of the ring M;

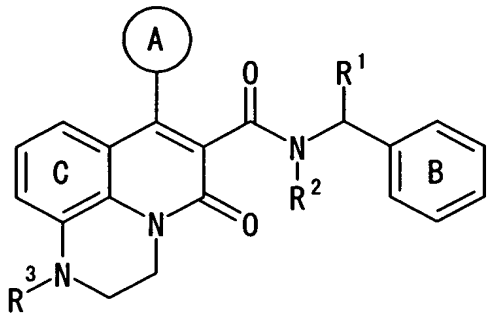
the rings A and B are each independently a substituted or unsubstituted homocyclic or heterocyclic ring, provided that at least one of the rings A and B is a substituted or unsubstituted heterocyclic ring; the ring C is a substituted or unsubstituted homocyclic or heterocyclic ring; the ring Z is a substituted or unsubstituted ring; and n is an integer from 1 to 6.

(9) Japanese Patent Laid-Open Publication No. Hei 11-246559 describes a compound represented by the following formula:



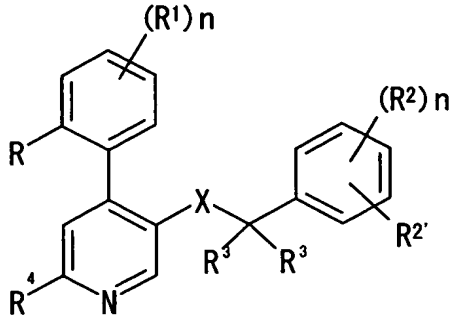
wherein X is a nitrogen atom or a CH group; R^1 is a hydrogen atom, a lower alkyl group, an aryl group, or an aralkyl group; R^2 is a hydrogen atom or a lower alkyl group; the rings A and B are each independently a substituted or unsubstituted benzene ring; and n is 1 or 2.

(10) Japanese Patent Laid-Open Publication No. 2000-139834 describes a compound represented by the following formula:



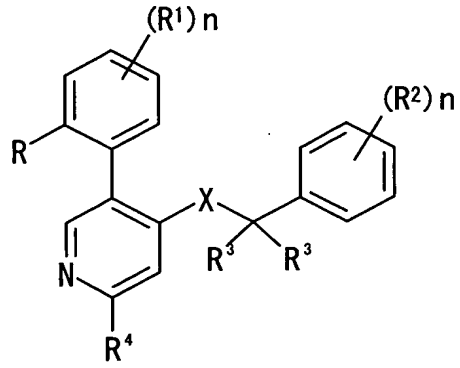
wherein R^1 and R^2 are each independently a hydrogen atom or a C_1 to C_6 alkyl group; R^3 is a hydrogen atom, a substituted or unsubstituted C_1 to C_6 alkylcarbonyl group, a substituted or unsubstituted C_1 to C_6 alkylsulfonyl group, a substituted or unsubstituted C_1 to C_6 alkyl group, a substituted or unsubstituted arylmethyl group or an alkoxycarbonyl group; the ring A is a homocyclic or heterocyclic ring which may include 1 through 3 independently selected substituents (any adjacent two of which may be bound to one another to form a ring); the ring B is a benzene ring which may include 1 through 5 substituents (any adjacent two of which may be bound to one another to form a ring); and the ring C is a benzene ring which may include 1 through 3 substituents (any adjacent two of which may be bound to one another to form a ring).

(11) Japanese Patent Laid-Open Publication No. 2000-247957 describes a compound represented by the following formula:



wherein R is a hydrogen atom or the like; R^1 is a hydrogen atom or the like; R^2 and $R^{2'}$ are each a hydrogen atom or the like; R^3 is a hydrogen atom or the like; R^4 is a hydrogen atom or the like; R^5 is a hydrogen atom or the like; R^6 is a hydrogen atom or the like; X is $-C(O)N(R^5)-$ or the like; n is an integer from 0 to 4; and m is 1 or 2.

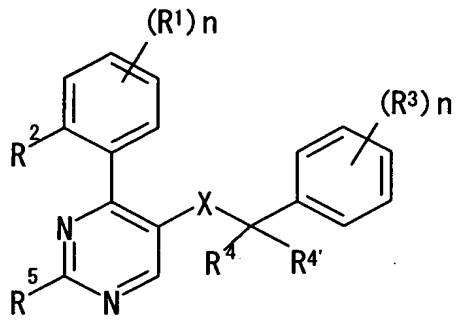
(12) PCT pamphlet (International Patent Publication) No. WO00/50401 describes a compound represented by the following formula:



wherein R is a hydrogen atom or the like; R^1 is a hydrogen atom or the like; R^2 is a hydrogen atom or the like; R^3 is a hydrogen atom or the like; R^4 is a hydrogen atom or the like; R^5 is a hydrogen atom or the like; R^6 is a hydrogen atom or the like; X is $-C(O)N(R^5)-$ or the like; n is an integer from 0 to

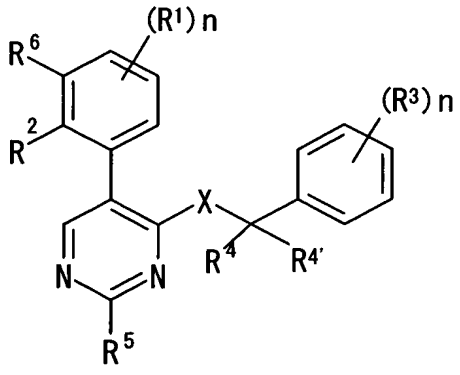
4; and m is 1 or 2.

(13) PCT pamphlet (International Patent Publication) No. WO00/73279 describes a compound represented by the following formula:



wherein R^1 is a hydrogen atom or the like; R^2 is a hydrogen atom or the like; R^3 is a hydrogen atom or the like; R^4 and $R^{4'}$ are each a hydrogen atom or the like; R^5 is a lower alkyl group or the like; n is an integer from 0 to 2; and X is -C(O)N($R^{4''}$)- or the like.

(14) PCT pamphlet (International Patent Publication) No. WO00/73278 describes a compound represented by the following formula:



wherein R^1 is a hydrogen atom or the like; R^2 is a hydrogen atom or the like; R^3 is a hydrogen atom or the like; R^4 and $R^{4'}$

are each a hydrogen atom or the like; R^5 is a lower alkyl group or the like; R^6 is a hydrogen atom or the like; n is an integer from 0 to 2; and X is $-C(O)N(R^{4''})-$ or the like.

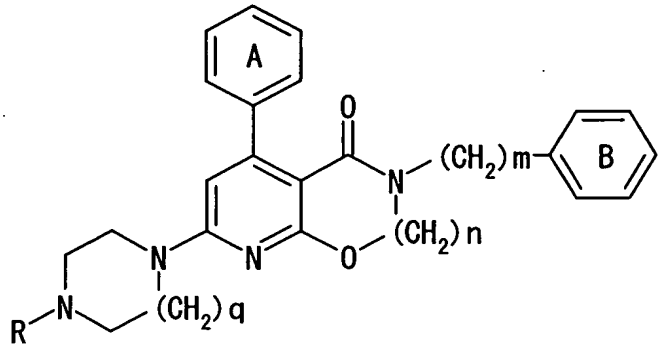
DISCLOSURE OF THE INVENTION

At present, no effective tachykinin receptor antagonists (in particular, NK1 receptor antagonists) are known that can serve as prophylactic or therapeutic agents against the above-described pathological conditions and at the same time meet requirements for pharmaceutical products, including safety, persistence of efficacy, pharmacokinetics, and pharmacological activities.

It is thus an objective of the present invention to provide a novel compound that acts as an effective tachykinin receptor antagonist and, in particular, as an NK1 receptor antagonist and can thus serve as a prophylactic or a therapeutic agent against various tachykinin receptor-related pathological conditions, including increased urinary frequency, incontinence of urine, vomiting, inflammation, allergies, respiratory tract disorders, pains, and central nervous system disorders.

The present inventors have discovered that fused bicyclic pyridine derivatives as represented by the following general formula (1), or salts thereof, can act as effective tachykinin receptor antagonists (in particular, as NK1 receptor

antagonists):

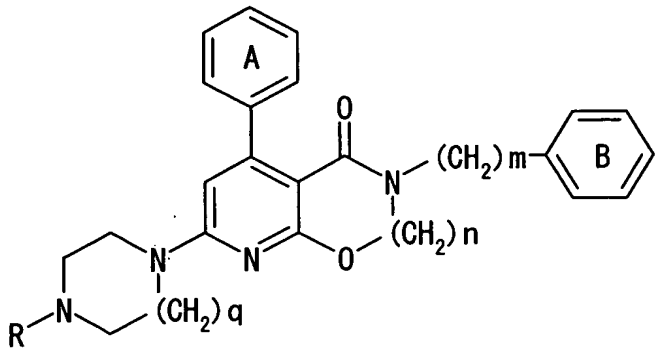


(1)

wherein the rings A and B are each a benzene ring that may include 1 through 3 substituents (any adjacent two of which may be bound to one anther to form a ring); R is a C_1 to C_6 alkylsulfonyl group, a C_1 to C_6 alkylcarbonyl group, a C_1 to C_6 alkoxycarbonyl group, or a formyl group; m is 1 or 2; n is 2 or 3; and q is 1 or 2. As evidence, the present inventors have demonstrated in animal experiments that these compounds can effectively relieve dysuria, a tachykinin-mediated disorder. This discovery led the present inventors to ultimately complete the present invention.

Accordingly, the present invention provides the followings:

(I) A fused bicyclic pyridine derivative represented by the following general formula (1), or a salt thereof:



(1)

wherein the rings A and B are each a benzene ring, which may have 1 to 3 substituents (any adjacent two of which may be bound to one another to form a ring) that are each independently selected from the group consisting of a halogen atom, a substituted or unsubstituted C_1 to C_6 alkyl group, and a substituted or unsubstituted C_1 to C_6 alkoxyl group;

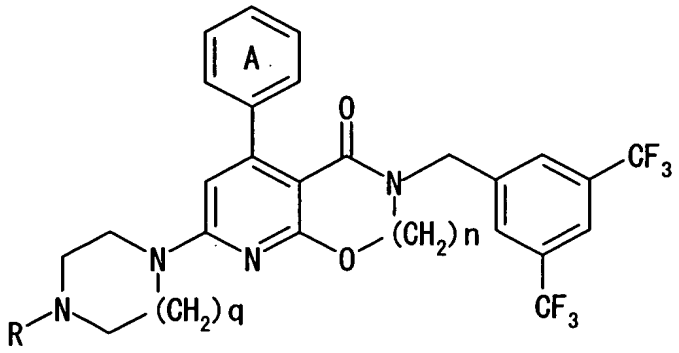
R is a C_1 to C_6 alkylsulfonyl group, a C_1 to C_6 alkylcarbonyl group, a C_1 to C_6 alkoxycarbonyl group, or a formyl group;

m is 1 or 2;

n is 2 or 3; and

q is 1 or 2.

(II) The fused bicyclic pyridine derivative according to (I) above represented by the following general formula (1a), or a salt thereof:



(1a)

wherein the ring A is a benzene ring, which may have 1 to 3 substituents (any adjacent two of which may be bound to one another to form a ring) that are each independently selected from the group consisting of a halogen atom, a substituted or unsubstituted C_1 to C_6 alkyl group, and a substituted or unsubstituted C_1 to C_6 alkoxyl group;

R is a C_1 to C_6 alkylsulfonyl group, a C_1 to C_6 alkylcarbonyl group, a C_1 to C_6 alkoxycarbonyl group, or a formyl group;

m is 1 or 2;

n is 2 or 3; and

q is 1 or 2.

(III) The fused bicyclic pyridine derivative according to (II) above, or a salt thereof, wherein in the general formula (1a) above, n is 3.

(IV) The fused bicyclic pyridine derivative according to (II) above, or a salt thereof, wherein in the general formula (1a) above, R is an acetyl group, and n is 3.

(V) The fused bicyclic pyridine derivative according to (II)

above, or a salt thereof, wherein in the general formula (1a) above, R is an acetyl group n is 3, and q is 1.

(VI) A tachykinin receptor antagonist containing as an active ingredient the fused bicyclic pyridine derivative according to any one of (I) through (V) above, or a salt thereof.

(VII) An NK1 receptor antagonist containing as an active ingredient the fused bicyclic pyridine derivative according to any one of (I) through (V) above, or a salt thereof.

(VIII) A prophylactic or therapeutic agent for dysuria, including defective bladder functions such as increased urinary frequency and incontinence of urine, containing as an active ingredient the fused bicyclic pyridine derivative according to any one of (I) through (V) above, or a salt thereof.

(IX) A prophylactic or therapeutic agent for disorders of digestive tract such as ulcerative colitis and Crohn's disease, containing as an active ingredient the fused bicyclic pyridine derivative according to any one of (I) through (V) above, or a salt thereof.

(X) A prophylactic or therapeutic agent for vomiting induced by exposure to X-ray, chemotherapy, pregnancy, migraine, postoperative pains, decreased gastrointestinal motility, and side effects of drugs, containing as an active ingredient the fused bicyclic pyridine derivative according to any one of (I) through (V) above, or a salt thereof.

(XI) A therapeutic agent for treating conditions, such as asthma, coughing, ache, migraine, tooth pain, and rheumatoid arthritis, containing as an active ingredient the fused bicyclic pyridine derivative according to any one of (I) through (V) above, or a salt thereof.

BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will now be described in detail.

Rings A and B

In the general formula (1), the rings A and B each independently represent a benzene ring, which may include 1 to 3 substituents (any adjacent two of which substituents may be bound to one another to form a ring). The substituents on each of the rings A and B may be positioned at any possible position with the number of the substituents on each ring varying from about 1 to 3. Any adjacent two of these substituents may be bound to each other to form a ring. Examples of the substituents on the rings A and B include a halogen atom, a substituted or unsubstituted C_1 to C_6 alkyl group, and a substituted or unsubstituted C_1 to C_6 alkoxyl group.

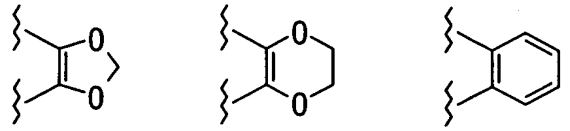
Examples of the halogen atoms include fluorine atom, chlorine atom, bromine atom, and iodine atom.

Examples of the " substituted or unsubstituted C_1 to C_6 alkyl group" include C_1 to C_6 alkyl groups having 1 to 3

hydrogen atoms substituted with halogen atoms. Specific examples include methyl group, ethyl group, propyl group, isopropyl group, isobutyl group, *sec*-butyl group, *tert*-butyl group, fluoromethyl group, chloromethyl group, bromomethyl group, iodomethyl group, 1-fluoroethyl group, 1-chloroethyl group, 2-chloroethyl group, difluoromethyl group, trifluoromethyl group, trichloromethyl group, and 2,2,2-trifluoroethyl group.

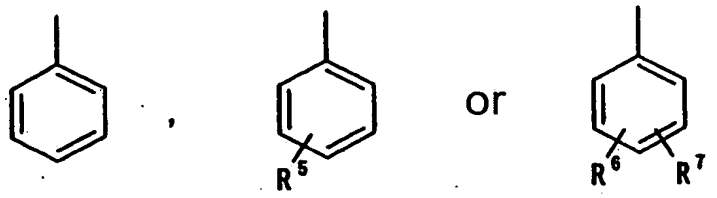
Examples of the " substituted or unsubstituted C_1 to C_6 alkoxyl group" include C_1 to C_6 alkoxyl groups having 1 to 3 hydrogen atoms substituted with halogen atoms. Specific examples include methoxy group, ethoxy group, propoxy group, isopropoxy group, isobutoxy group, sec-butoxy group, tert-butoxy group, fluoromethoxy group, chloromethoxy group, bromomethoxy group, iodomethoxy group, 1-fluoroethoxy group, 1-chloroethoxy group, 2-fluoroethoxy group, difluoromethoxy group, trifluoromethoxy group, trichloromethoxy group, and 2,2,2-trifluoroethoxy group.

Examples of the "rings in which two adjacent substituents are bound to each other to form a ring" include the followings:



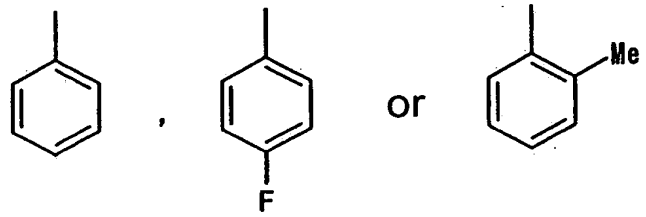
Ring A

Preferred examples of the ring A are those represented by the following formulae:



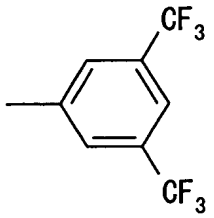
wherein R^5, R^6, and R^7 are each independently a fluorine atom, a chlorine atom, a methyl group, an ethyl group, a trifluoromethyl group, or a methoxy group.

Particularly preferred examples of the ring A are those represented by the following formulae:



Ring B

Particularly preferred examples of the ring B are those represented by the following formulae:



R

R is a C_1 to C_6 alkylsulfonyl group, a C_1 to C_6 alkylcarbonyl group, a C_1 to C_6 alkoxycarbonyl group, or a

formyl group.

Examples of the "C_1 to C_6 alkylsulfonyl group" include methylsulfonyl group, ethylsulfonyl group, and propylsulfonyl group.

Examples of the "C_1 to C_6 alkylcarbonyl group" include acetyl group, propionyl group, and butyryl group.

Examples of the "C_1 to C_6 alkoxycarbonyl group" include methoxycarbonyl group, ethoxycarbonyl group, isopropoxycarbonyl group, and t-butoxycarbonyl group.

m

m is 1 or 2, and preferably 1.

n

n is 2 or 3, and preferably 3.

q

q is 1 or 2, and preferably 1.

Preferred examples of the compounds of the present invention include 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methoxyphenyl)-6-oxo-

2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; 8-(4-acetylpiperazine-1-yl)-4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine; 9-(4-acetylhomopiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; 9-(4-acetylhomopiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine;

9-(4-acetylhomopiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; 8-(4-acetylhomopiperazine-1-yl)-4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine; 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-9-[4-(methylsulfonyl)piperazine-1-yl]-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine; and 5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-9-[4-(methylsulfonyl)piperazine-1-yl]-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine.

Salts

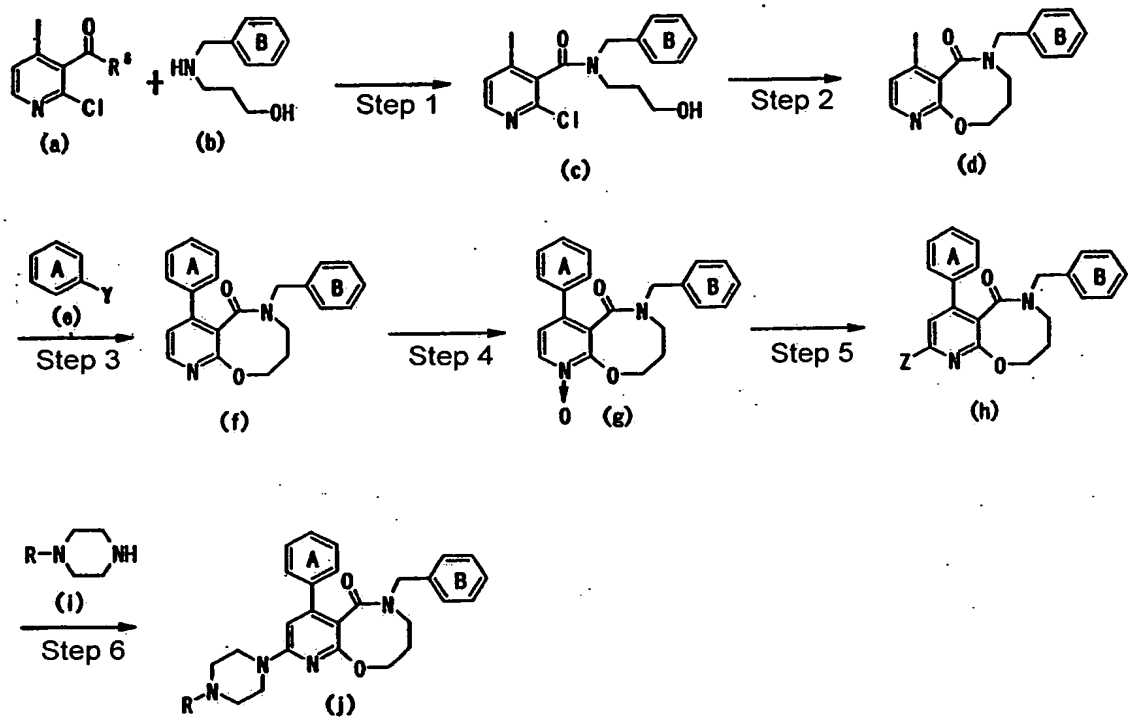
Examples of pharmaceutically acceptable salts of the compounds of the present invention include those formed with inorganic acids, such as hydrochloric acid, hydrobromic acid, sulfuric acid, and nitric acid, and those formed with organic

acids, such as acetic acid, maleic acid, fumaric acid, succinic acid, lactic acid, malic acid, tartaric acid, citric acid, methanesulfonic acid, *p*-toluenesulfonic acid, salicylic acid, stearic acid, and palmitic acid.

Aside from racemic mixtures, the compounds of the present invention or salts thereof may be provided in the form of optically active forms, stereoisomers, or atrop isomers.

The compounds of the present invention or salts thereof may also exist in the form of hydrates or solvates. The present invention encompasses any hydrates or solvates formed by the fused bicyclic pyridine derivatives of the general formula (1a), including the preferred compounds specifically mentioned above, or salts thereof. Examples of the solvents that can form solvates include methanol, ethanol, isopropanol, acetone, ethyl acetate, methylene chloride, and diisopropylether.

Various synthetic techniques may be used to produce the compounds of the present invention. One commonly used production process of the compounds of the present invention or salts thereof is described below.



(Step 1)

In this step, a compound (a) (wherein R^8 represents a hydroxyl group, a halogen atom, a 1-imidazolyl group, a 4-nitrophenoxy group, an imidoyloxy succinate group, a C_1 to C_6 alkoxyl group, a benzyloxy group, or the like) and a compound (b) (wherein the ring B is as described above) are allowed to undergo condensation to generate a compound (c) (wherein the ring B is as described above). When R^8 is a hydroxyl group, a suitable condensation agent for use in the condensation reaction in this step may be dicyclohexylcarbodiimide (DCC), 3-ethyl-1-(3-dimethylaminopropyl)carbodimide hydrochloride (EDCI), or dimethylimidazolinium chloride (DMC). These condensation agents may be added in the form of a solid product or a solution in a proper solvent. A base may be used

in the condensation reaction, including alkali carbonates, such as sodium hydrogen carbonate, or potassium carbonate, and tertiary amines, such as triethylamine, diisopropylethylamine, N-methylmorpholine, diazabicyclo[5.4.0]-7-undecene, pyridine, 4-dimethylaminopyridine, or 1,8-bis(dimethylamino)naphthalene. The solvent for use in the condensation reaction may be any inert solvent that does not take part in the reaction, including N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, acetonitrile, tetrahydrofuran, dioxane, ethyl ether, dimethoxyethane, ethyl acetate, and dichloromethane. The condensation reaction may be carried out at -20°C to 80°C. When the compound (b) for use in the condensation reaction in this step is any of a halide of a carboxylic acid, an imidazolide of a carboxylic acid, or an active ester of a carboxylic acid, in which R^8 is a halogen atom, a 1-imidazolyl group, a 4-nitrophenoxy group or an imidoyloxy succinate group, the reaction can be carried out by allowing the reactants to react in the presence or absence of an organic base, such as triethylamine, diisopropylethylamine, pyridine or 4-dimethylaminopyridine, or an inorganic base, such as sodium hydrogen carbonate or potassium carbonate, in a solvent, such as N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, acetonitrile, tetrahydrofuran, dioxane, ethyl ether, dimethoxyethane, ethyl acetate, toluene, or dichloromethane, at -20°C to 80°C for 30 min. to 48 hours.

When R^8 is an ester residue such as a C_1 to C_6 alkoxyl group and a benzyloxy group in the condensation reaction in this step, the reaction can be carried out by allowing the reactants to react in the presence or absence of trimethylaluminum or tetraisopropoxytitanium or in the presence or absence of an acidic or a basic catalyst, such as *p*-toluenesulfonic acid, sodium methoxide, potassium t-butoxide, or sodium hydride, in a solvent, such as N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, acetonitrile, tetrahydrofuran, dioxane, toluene, xylene, mesitylene, pyridine, quinoline, or dichloromethane, at 15°C to 150°C for 30 min. to 48 hours.

(Step 2)

In this step, the compound (c) (wherein the ring B is as described above) is cyclized to generate a compound (d) (wherein the ring B is as described above). The step may be carried out by allowing the cyclization to take place in the presence or absence of an organic base, such as sodium-*tert*-butoxide or potassium-*tert*-butoxide, or an inorganic base, such as sodium hydride, potassium carbonate, sodium carbonate, cesium carbonate, or sodium acetate, in a solvent, such as N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, acetonitrile, tetrahydrofuran, dioxane, toluene, xylene, mesitylene, pyridine, quinoline, or dichloromethane, at 0°C to 150°C for 30 min. to 48 hours.

(Step 3)

In this step, the compound (d) (wherein the ring B is as described above) and a compound (e) (wherein the ring A is as described above, Y is a halogen atom, OSO_2R^9 (wherein R^9 is a C_1 to C_6 alkyl group, which may be substituted with halogen atoms), or $B(R^{10})_2$ (wherein the R^{10} substituents are each independently a hydroxyl group, a C_1 to C_6 alkyl group or a C_1 to C_6 alkoxyl group, or R^{10} substituents may be bound to each other to form a ring)) are allowed to undergo a cross-coupling reaction in the presence of a transitional metal catalyst, such as a palladium or nickel complex to generate a compound (f) (wherein the rings A and B are as described above). Preferably, the process is carried out by using an inert solvent that does not take part in the process. Examples of the solvent include N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, acetonitrile, tetrahydrofuran, dioxane, dichloromethane, toluene, ethanol or water. These solvents may be used individually or may be mixed with one another in any proportion. Examples of the palladium complexes for use in the process include palladium chloride, palladium acetate, acetylacetonato palladium, and tetrakis(triphenylphosphine)palladium. Examples of the nickel complexes for use in the process include bis(acetylacetonato)nickel, bis(1,5-cyclooctadiene)nickel, and tetrakis(triphenylphosphine)nickel. Each of these palladium or

nickel complexes is used in an amount of 0.001 to 1 equivalent, preferably in an amount of 0.01 to 0.1 equivalents, with respect to the compound (d). When it is desired to use a ligand for the palladium or nickel complex in the process, the ligand may be triphenylphosphine, tri-o-tolylphosphine, tri-2-furylphosphine, 1,2-bis(diphenylphosphino)ethane, 1,1'-bis(diphenylphosphino)ferrocene, or 2,2'-bis(diphenylphosphino)-1,1'-binaphthyl. Each of these ligands is used in an amount of 0.2 to 5 equivalents, preferably in an amount of 0.3 to 3 equivalents, with respect to the palladium or nickel complex. Preferably, the process is carried out in the presence of a proper base. Among such bases are organic bases, including triethylamine, tributylamine, diisopropylethylamine, N-methylmorpholine, pyridine, lutidine, and collidine, and inorganic bases, including sodium hydrogen carbonate, sodium carbonate, potassium carbonate, calcium carbonate, cesium carbonate, and tripotassium phosphate. Each of these bases is used in an amount of 1 to 20 equivalents, preferably in an amount of 2 to 10 equivalents, with respect to the compound (d). The cross-coupling reaction in this step is carried out by allowing the reactants to undergo the reaction at 15 to 150°C, preferably at 50 to 120°C, for 30 min. to 24 hours.

(Step 4)

In this step, the compound (f) (wherein the rings A and B

are as described above) is oxidized at the nitrogen on its pyridine ring to generate a compound (g) (wherein the rings A and B are as described above). The step may be carried out by using a peroxide (such as m-chloroperbenzoic acid, hydrogen peroxide, and peracetic acid) in an amount of 1 to 10 equivalents, preferably in an amount of 1 to 2 equivalents, with respect to the compound (f) and by allowing oxidization to proceed at -20°C to 80°C, preferably at 0 to 30°C, for 30 min. to 72 hours. The solvent for use in this step may be dichloromethane, toluene, ethyl acetate, dimethoxyethane, ethyl ether, dioxane, tetrahydrofuran, acetonitrile, N,N-dimethylformamide, and N,N-dimethylacetamide.

(Step 5)

In this step, Z (wherein Z represents a halogen atom) is introduced into the compound (g) (wherein the rings A and B are as described above) with the help of the N-oxide to generate a compound (h). For example, in a case where Z is a chlorine atom, this step may be carried out by using a chlorinating agent such as phosphorus oxychloride, pivaloyl chloride, or oxalyl chloride in an amount of 1 to 20 equivalents, preferably in an amount of 2 to 10 equivalents, with respect to the compound (g) and by allowing the reaction to proceed at 15 to 120°C, preferably at 80 to 120°C, for 30 minutes to 24 hours. In a case where it is desired to use a base in the process, examples of such a base include

triethylamine, tributylamine, diisopropylethylamine, N-methylmorpholine, pyridine, lutidine, and collidine. In a case where it is desired to use a solvent, an inert solvent that is not involved in the reaction, such as dichloromethane, xylene, toluene, dioxane, or tetrahydrofuran can be used.

(Step 6)

In this step, the compound (h) (wherein Z, and the rings A and B are as described above) is reacted with a compound (i) (wherein R is as described above) to generate a compound (j) (R, and the rings A and B are as described above). The reaction can be carried out by using the compound (i) in an amount of 1 to 20 equivalents of the compound (h) and allowing the reactants to react in the presence or absence of a base at 80 to 200°C, preferably at 120 to 150°C, for 30 min. to 24 hours. A base may preferably be used, including organic bases, such as triethylamine, tributylamine, diisopropylethylamine, N-methylmorpholine, pyridine, lutidine, collidine, and N,N-dimethylaniline, and inorganic bases, such as sodium hydrogen carbonate, sodium carbonate, potassium carbonate, calcium carbonate, cesium carbonate, and tripotassium phosphate. When it is desired to use a solvent, such a solvent may be any inert solvent that is not involved in the reaction, including N,N-dimethylformamide, N,N-dimethylacetamide, sulfolane, acetonitrile, tetrahydrofuran, dioxane, xylene, toluene, ethanol and water.

The compounds (1) of the present invention can be isolated/purified by ordinary means (for example, extraction, recrystallization, distillation, and chromatography). When the resulting compounds tend to form salts, such salts can be produced by ordinary techniques or equivalent techniques (for example, neutralization).

The compounds (1) of the present invention or salts thereof act as tachykinin receptor antagonists, in particular NK1 receptor antagonists, and are thus useful as: prophylactic or therapeutic agents for dysuria, including defective bladder functions such as increased urinary frequency and incontinence of urine; prophylactic or therapeutic agents for disorders of digestive tract such as ulcerative colitis and Crohn's disease; prophylactic or therapeutic agents for vomiting induced by exposure to X-ray, chemotherapy, pregnancy, migraine, postoperative pains, decreased gastrointestinal motility, and side effects of drugs; prophylactic or therapeutic agents for vomiting induced by exposure to X-ray, chemotherapy, pregnancy, migraine, postoperative pains, decreased gastrointestinal motility, and side effects of drugs; and therapeutic agents for asthma, coughing, ache, migraine, tooth pain, rheumatoid arthritis and other conditions.

The compounds (1) of the present invention or salts thereof may be used individually, or they may be formed into

pharmaceutical compositions along with one or more pharmaceutically acceptable adjuvants. Specifically, the compounds of the present invention may be mixed with pharmaceutically acceptable carriers, excipients (such as starch, lactose, calcium phosphate, and calcium carbonate), lubricants (such as magnesium stearate, calcium stearate talc, and stearic acid), binders (such as starch, cellulose crystals, carboxymethylcellulose, gum Arabic, polyvinylpyrrolidone, and alginic acid), disintegrating agents (such as talc, and carboxymethylcellulose calcium), and diluents (such as physiological saline, and aqueous solutions of glucose, mannitol, and lactose). Using ordinary techniques, the compounds of the present invention may be prepared as tablets, capsules, granules, powders, fine granules, ampules, or injections for oral or parenteral administration. While the dosage of the compounds (1) of the present invention or salts thereof may vary depending on the type of salt, route of administration, and age and conditions of patients, a typical dose for humans and other mammals, for example, is in the range of 0.0001 to 300mg/kg/day as measured by the amount of the compounds (1) of the present invention or salts thereof. The compounds (1) or salts thereof may be administered in a single dose or several doses each day.

EXAMPLES

The present invention will now be described in detail with reference to Examples, Reference Examples, and Test Examples, as will an exemplary production process of a starting material of the compounds (1) of the present invention, which is also a novel compound. It should be appreciated that the compounds of the present invention are not limited to those described in the following examples and may be modified without departing from the scope and the spirit of the invention.

<Reference Example 1>

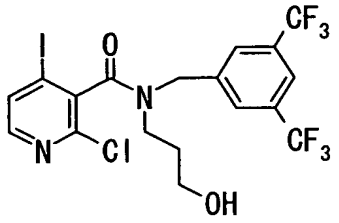
To a tetrahydrofuran solution of lithium diisopropylamide (which was prepared by diluting diisopropylamine (14.6mL) with tetrahydrofuran (200mL), adding n-butyllithium (69.5mL, 1.5mol/L hexane solution) at -20°C, and then stirring the mixture at -20°C for 30 minutes), a tetrahydrofuran solution (100mL) of 2-chloro-3-iodopyridine (23.8g) was added at -78°C, and the mixture was stirred for 5 hours. Carbon dioxide was then bubbled through the reaction mixture for 1 hour, and water was added. The temperature of the mixture was then allowed to rise to room temperature. Following the addition of 2mol/L hydrochloric acid (200mL) to adjust the pH of the

mixture to a value of 1, the mixture was subjected to extraction with a 1 : 1 (v/v) mixture of tetrahydrofuran and ethyl acetate, and then the resulting extract was dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue. To this residue, ethyl acetate was added, and the resulting crystals were collected by filtration. As a result, 2-chloro-4-iodonicotinic acid was obtained (22.7g, 81%).

MS(EI)*m/z*: 283(M^+)

HRMS(EI): Calcd for $C_6H_3ClINO_2$: 282.8897; found: 282.8896

<Reference Example 2>



2-Chloro-4-iodonicotinic acid (compound of Reference Example 1; 8.40g) and N,N-dimethylformamide (3 droplets) were added to thionyl chloride (20mL), and the mixture was stirred at 100°C for 3 hours. The reaction mixture was distilled under reduced pressure to obtain a yellow residue.

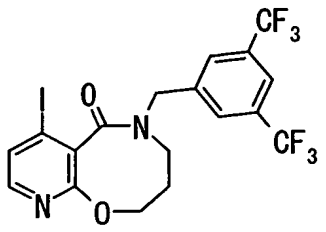
3-(3,5-Bis(trifluoromethyl)benzylamino)propanol (which was prepared according to a method described in Japanese Patent Laid-open Publication No. Hei 9-263585; 10.7g) and triethylamine (20.6mL) were dissolved in tetrahydrofuran (150mL). While the resulting solution was chilled on an ice

bath, a tetrahydrofuran solution (50mL) of the yellow residue was added. After stirred for 1 hour, the mixture was further stirred at room temperature for additional two hours. Subsequently, water was added to the reaction mixture, and then the resulting mixture was subjected to extraction with ethyl acetate. The resulting extract was dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was purified on a silica gel column chromatography (ethyl acetate: n-hexane = 3: 1) to obtain N-[3,5-bis(trifluoromethyl)benzyl]-2-chloro-N-(3-hydroxypropyl)-4-iodonicotinamide (15.4g, 92%).

MS(EI)*m/z*: 566 (M^+)

HRMS(EI): Calcd for $C_{18}H_{14}ClF_6N_2O_2$: 565.9693; found: 565.9731

<Reference Example 3>



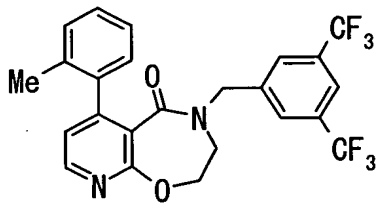
N-[3,5-Bis(trifluoromethyl)benzyl]-2-chloro-N-(3-hydroxypropyl)-4-iodonicotinamide (compound of Reference Example 2; 6.86g) was dissolved in tetrahydrofuran (60mL). While the resulting solution was chilled on an ice bath, sodium hydride (581mg, 60% oil suspension) was added, and the mixture was stirred for 30 minutes. The temperature of the mixture was then allowed to rise to room temperature, and the

mixture was further stirred for 1 hour. While the reaction mixture was chilled on an ice bath, water was added, and then the resulting mixture was subjected to extraction with ethyl acetate. The resulting extract was washed with a saturated aqueous solution of sodium chloride, and was then dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was purified on a silica gel column chromatography (ethyl acetate: n-hexane = 2: 1) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-iodo6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (2.69g, 42%).

MS(EI)*m/z*: 530 (M^+)

HRMS(EI): Calcd for $C_{18}H_{13}F_6IN_2O_2$: 529.9926; found: 529.9907

<Reference Example 4>



2-Chloro-4-(2-methylphenyl)nicotinic acid (compound of Reference Example 9; 670mg) and N,N-dimethylformamide (2 droplets) were added to thionyl chloride (2.0mL). While heated, the mixture was refluxed for 1 hour. The reaction mixture was distilled under reduced pressure to obtain a yellow residue.

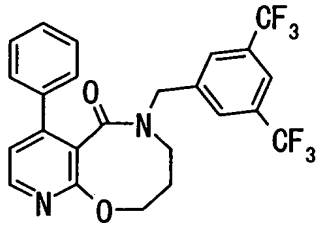
3-(3,5-Bis(trifluoromethyl)benzylamino)propanol (which was prepared according to a method described in Japanese

Patent Laid-open Publication No. Hei 9-263585; 818mg) and triethylamine (1.9mL) were dissolved in tetrahydrofuran (8mL). While the resulting solution was chilled on an ice bath, a tetrahydrofuran solution (2mL) of the yellow residue was added. After stirred for 1 hour, the mixture was further stirred at room temperature for an additional 1 hour. Subsequently, the reaction mixture was diluted with ethyl acetate. The diluted mixture was successively washed with water, a saturated aqueous solution of sodium hydrogen carbonate, a 20% aqueous solution of citric acid, and a saturated aqueous solution of sodium chloride, and was then dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was dissolved in tetrahydrofuran (8mL). While the resulting solution was chilled on an ice bath, potassium-t-butoxide (365mg) was added. After stirred for 1 hour, the mixture was further stirred at room temperature for an additional 1 hour. After diluted with ethyl acetate, the reaction mixture was successively washed with water and a saturated aqueous solution of sodium chloride, and was then dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was purified on a silica gel column chromatography (ethyl acetate: n-hexane = 2: 1) to obtain 4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (590mg, 45%).

MS(EI)*m/z*: 480 (M^+)

HRMS(EI): Calcd for $C_{24}H_{18}F_6N_2O_2$: 480.1272; found: 480.1293

<Reference Example 5>

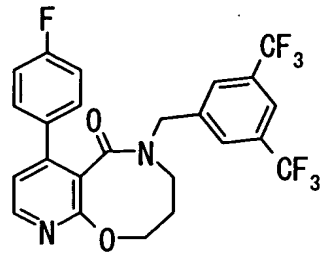


Phenylboronic acid (417mg), tetrakis(triphenylphosphine)palladium (132mg), toluene (10mL), 1,4-dioxane (5mL), and a 2mol/L aqueous solution of sodium carbonate (10mL) were added to 5-[3,5-bis(trifluoromethyl)benzyl]-7-iodo6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 3; 1.00g). While heated, the mixture was stirred for 7 hours under a stream of argon gas. The reaction mixture was diluted with ethyl acetate, and the diluted mixture was washed with a 2mol/L aqueous solution of sodium carbonate, and was then dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was recrystallized from isopropanol to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (729mg, 80%).

MS(EI)*m/z*: 480 (M^+)

HRMS(EI): Calcd for $C_{24}H_{18}F_6N_2O_2$: 480.1272; found: 480.1286

<Reference Example 6>

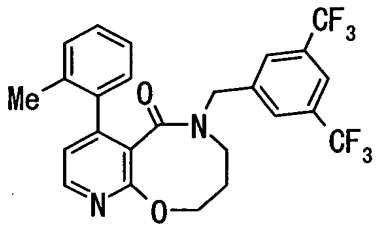


In a similar manner to Reference Example 5, 5-[3,5-bis(trifluoromethyl)benzyl]-7-iodo6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 3; 300mg) was reacted with 4-fluorophenylboronic acid (143mg) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (284mg, 100%).

MS(EI)*m/z*: 498 (M^+)

HRMS(EI): Calcd for $C_{24}H_{17}F_7N_2O_2$: 498.1178; found: 498.1168

<Reference Example 7>

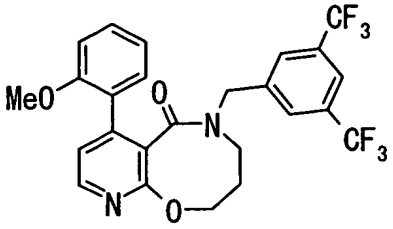


In a similar manner to Reference Example 5, 5-[3,5-bis(trifluoromethyl)benzyl]-7-iodo6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 3; 300mg) was reacted with 2-methylphenylboronic acid (116mg) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (278mg, 99%).

MS(EI)*m/z*: 494 (M^+)

HRMS(EI): Calcd for $C_{25}H_{20}F_6N_2O_2$: 494.1429; found: 494.1441

<Reference Example 8>

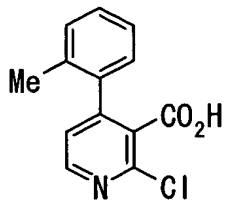


In a similar manner to Reference Example 5, 5-[3,5-bis(trifluoromethyl)benzyl]-7-iodo6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 3; 2.00g) was reacted with 2-methoxyphenylboronic acid (690mg) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methoxyphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (1.65g, 86%).

MS(EI)*m/z*: 510 (M^+)

HRMS(EI): Calcd for $C_{25}H_{20}F_6N_2O_3$: 510.1378; found: 510.1397

<Reference Example 9>

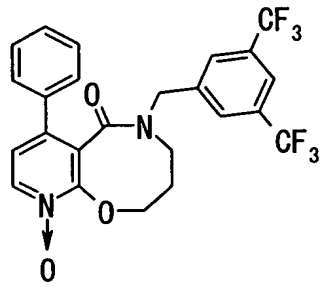


In a similar manner to Reference Example 5, 2-chloro-4-iodonicotinic acid (compound of Reference Example 1; 5.67g) was reacted with 2-methylphenylboronic acid (3.00g) to obtain 2-chloro-4-(2-methylphenyl)nicotinic acid (4.44g, 90%).

MS(EI)*m/z*: 247 (M^+)

HRMS(EI): Calcd for $C_{13}H_{10}ClNO_2$: 247.0400; found: 247.0410

<Reference Example 10>

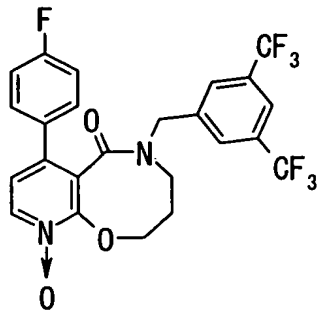


5-[3,5-Bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 5; 729mg) was dissolved in methylene chloride (10mL). To the resulting solution, 3-chloroperbenzoic acid (524mg) was added, and then the mixture was stirred at room temperature for 24 hours. The reaction mixture was purified on a silica gel column chromatography (ethyl acetate: methanol = 5: 1) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (411mg, 54%).

MS(FAB^+)*m/z*: 497 ($M+H^+$)

HRMS(FAB^+): Calcd for $C_{24}H_{19}F_6N_2O_3$: 497.1300; found: 497.1291

<Reference Example 11>

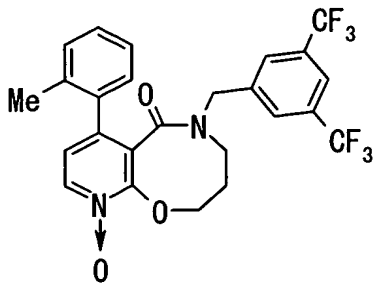


In a similar manner to Reference Example 10, 5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 6; 272mg) was used to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (119mg, 42%).

MS(FAB$^+$)*m/z*: 515 ($M+H^+$)

HRMS(FAB$^+$): Calcd for $C_{24}H_{18}F_7N_2O_3$: 515.1206; found: 515.1230

<Reference Example 12>



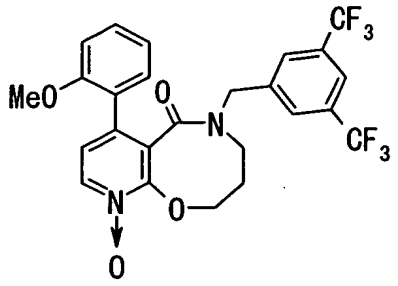
In a similar manner to Reference Example 10, 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 7; 270mg) was used to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-

tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (231mg, 83%).

MS(FAB$^+$)*m/z*: 511 (M+H$^+$)

HRMS(FAB$^+$): Calcd for $C_{25}H_{21}F_6N_2O_3$: 511.1456; found: 511.1469

<Reference Example 13>

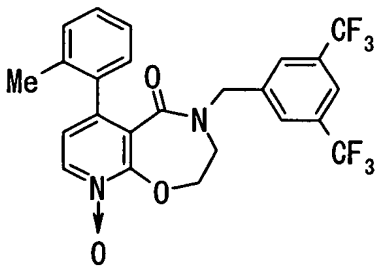


In a similar manner to Reference Example 10, 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methoxyphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 8; 1.58g) was used to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methoxyphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (1.34g, 82%).

MS(FAB$^+$)*m/z*: 527 (M+H$^+$)

HRMS(FAB$^+$): Calcd for $C_{25}H_{21}F_6N_2O_4$: 527.1406; found: 527.1412

<Reference Example 14>



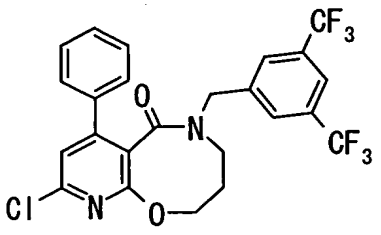
In a similar manner to Reference Example 10, 4-[3,5-

bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (compound of Reference Example 4; 530mg) was used to obtain 4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine 10-oxide (333mg, 61%).

MS(FAB$^+$)*m/z*: 497 ($M+H^+$)

HRMS(FAB$^+$): Calcd for $C_{24}H_{19}F_6N_2O_3$: 497.1300; found: 497.1311

<Reference Example 15>

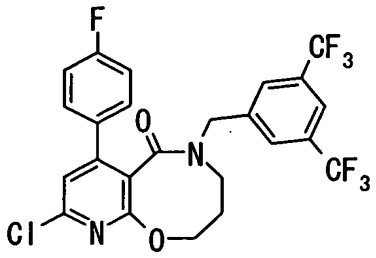


5-[3,5-Bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (compound of Reference Example 10; 400mg) was added to phosphorus oxychloride (1.5mL), and the mixture was refluxed for 1 hour while heated. The solvent was removed by distillation to obtain a residue. To this residue, ethyl acetate was added, and then the resulting crystals were collected. As a result, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine was obtained (440mg, 99%).

MS(EI)*m/z*: 514 (M^+)

HRMS(EI): Calcd for $C_{24}H_{17}ClF_6N_2O_2$: 514.0883; found: 514.0865

<Reference Example 16>

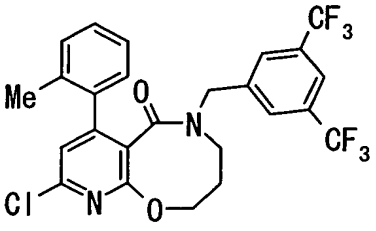


In a similar manner to Reference Example 15, 5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (compound of Reference Example 11; 114mg) was used to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (118mg, 100%).

MS(EI)*m/z*: 532 (M^+)

HRMS(EI): Calcd for $C_{24}H_{16}ClF_7N_2O_2$: 532.0798; found: 532.0801

<Reference Example 17>



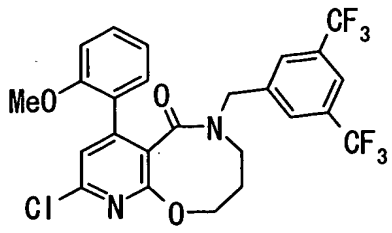
In a similar manner to Reference Example 15, 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (compound of Reference Example 12; 220mg) was used to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (228mg,

100%).

MS(EI)*m/z*: 528 (M^+)

HRMS(EI): Calcd for $C_{25}H_{19}ClF_6N_2O_2$: 528.1039; found: 528.1063

<Reference Example 18>

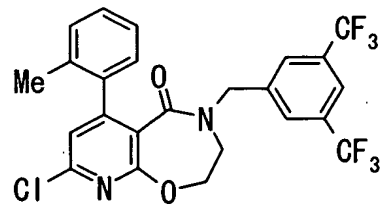


In a similar manner to Reference Example 15, 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methoxy phenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine 10-oxide (compound of Reference Example 13; 1.25g) was used to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(2-methoxyphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (1.29g, 100%).

MS(EI)*m/z*: 544 (M^+)

HRMS(EI): Calcd for $C_{25}H_{19}ClF_6N_2O_3$: 544.0988; found: 544.0980

<Reference Example 19>



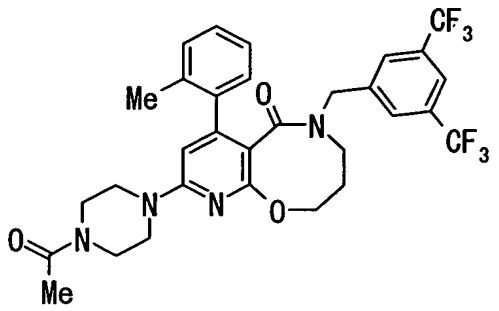
In a similar manner to Reference Example 15, 4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine 10-oxide (compound of

Reference Example 14; 310mg) was used to obtain 4-[3,5-bis(trifluoromethyl)benzyl]-8-chloro-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (320mg, 100%).

MS(EI)*m/z*: 514 (M^+)

HRMS(EI): Calcd for $C_{24}H_{17}ClF_6N_2O_2$: 514.0883; found: 514.0840

<Example 1>

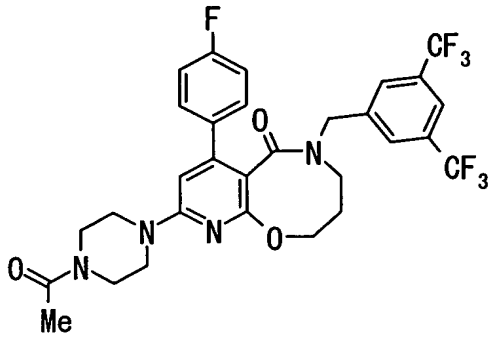


A mixture of 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 17; 100mg) and 1-acetylpiperazine (73.0mg) was stirred at 150°C for 5 hours. To the resulting residue, water was added, and then the mixture was subjected to extraction with ethyl acetate. The resulting extract was dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was purified on silica gel column chromatography (ethyl acetate: methanol = 10: 1) to obtain 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (44.6mg, 38%).

MS(EI)*m/z*: 620 (M^+)

HRMS(EI): Calcd for $C_{31}H_{30}F_6N_4O_3$: 620.2222; found: 620.2224

<Example 2>

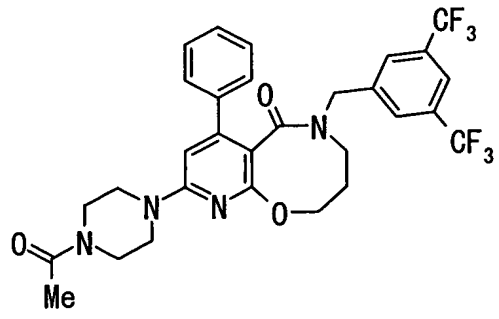


In a similar manner to Example 1, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 16; 100mg) was reacted with 1-acetylpiperazine (73.0mg) to obtain 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (50.9mg, 43%).

MS(EI)*m/z*: 624 (M^+)

HRMS(EI): Calcd for $C_{30}H_{27}F_7N_4O_3$: 624.1971; found: 624.1954

<Example 3>



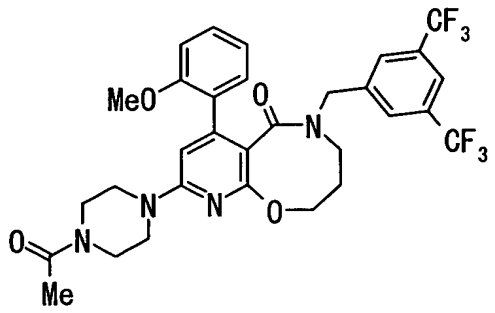
In a similar manner to Example 1, 5-[3,5-

bis(trifluoromethyl)benzyl]-9-chloro-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 15; 52.0mg) was reacted with 1-acetylpiperazine (38.8mg) to obtain 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (32.8mg, 54%).

MS(EI)*m/z*: 606 (M^+)

HRMS(EI): Calcd for $C_{30}H_{28}F_6N_4O_3$: 606.2066; found: 606.2047

<Example 4>

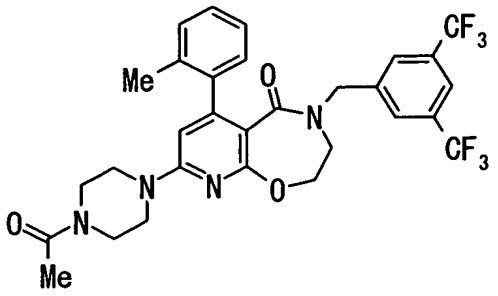


In a similar manner to Example 1, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(2-methoxyphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 18; 82.0mg) was reacted with 1-acetylpiperazine (57.7mg) to obtain 9-(4-acetylpiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methoxyphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (48.2mg, 50%).

MS(EI)*m/z*: 636 (M^+)

HRMS(EI): Calcd for $C_{31}H_{30}F_6N_4O_4$: 636.2171; found: 636.2140

<Example 5>

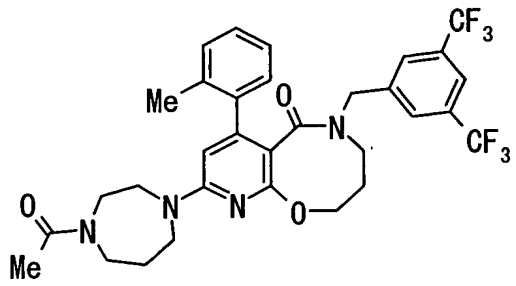


In a similar manner to Example 1, 4-[3,5-bis(trifluoromethyl)benzyl]-8-chloro-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (compound of Reference Example 19; 51.5mg) was reacted with 1-acetylpiperazine (38.5mg) to obtain 8-(4-acetylpiperazine-1-yl)-4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (6.0mg, 10%).

MS(EI)*m/z*: 606 (M^+)

HRMS(EI): Calcd for $C_{30}H_{28}F_6N_4O_3$: 606.2066; found: 606.2022

<Example 6>



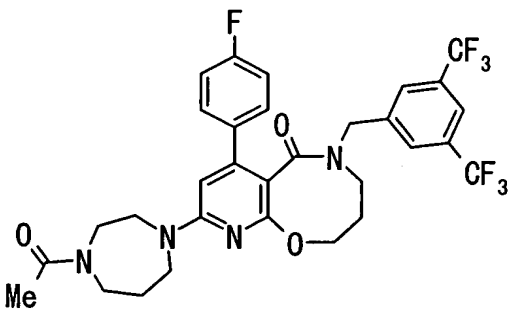
A mixture of 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 17; 100mg) and 1-(t-butoxycarbonyl)homopiperazine (95.0mg) was stirred at 150°C for 5 hours.

While the resulting residue was chilled on an ice bath, a 3mol/L ethyl acetate solution of hydrogen chloride (1mL) was added, and then the mixture was stirred at room temperature for 1 hour. The solvent was removed by distillation to obtain a residue, and then the residue was dissolved in tetrahydrofuran (1mL). While the resulting solution was chilled on an ice bath, triethylamine (0.2mL) and acetic anhydride (0.1mL) were added, and then the mixture was stirred for 1 hour. To the reaction mixture, ethyl acetate was added. The resulting mixture was washed with water, and was then dried on anhydrous sodium sulfate. The solvent was removed by distillation to obtain a residue, and then the residue was purified on a silica gel column chromatography (ethyl acetate: methanol =10: 1) to obtain 9-(4-acetylhomopiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (42.7mg, 36%).

MS(EI)*m/z*: 634 (M^+)

HRMS(EI): Calcd for $C_{32}H_{32}F_6N_4O_3$: 634.2379; found: 634.2381

<Example 7>

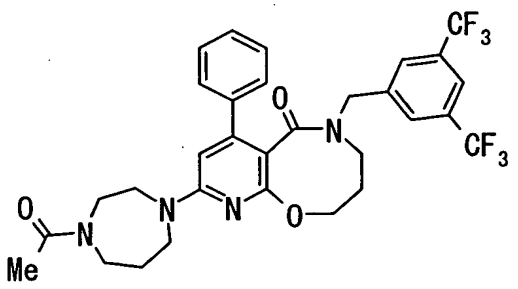


In a similar manner to Example 6, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine(compound of Reference Example 16; 80.0mg) was reacted with 1-(t-butoxycarbonyl)homopiperazine (75.1mg) and acetic anhydride (70μL) to obtain 9-(4-acetylhomopiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl)-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (33.4mg, 35%).

MS(EI)*m/z*: 638 (M^+)

HRMS(EI): Calcd for $C_{31}H_{29}F_7N_4O_3$: 638.2128; found: 638.2144

<Example 8>

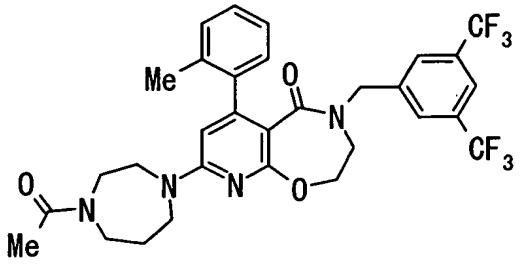


In a similar manner to Example 6, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 15; 52.0mg) was reacted with 1-(t-butoxycarbonyl)homopiperazine (50.6mg) and acetic anhydride (50μL) to obtain 9-(4-acetylhomopiperazine-1-yl)-5-[3,5-bis(trifluoromethyl)benzyl]-6-oxo-7-phenyl-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (31.7mg, 51%).

MS(EI)*m/z*: 620 (M^+)

HRMS(EI): Calcd for $C_{31}H_{30}F_6N_4O_3$: 620.2222; found: 620.2197

<Example 9>

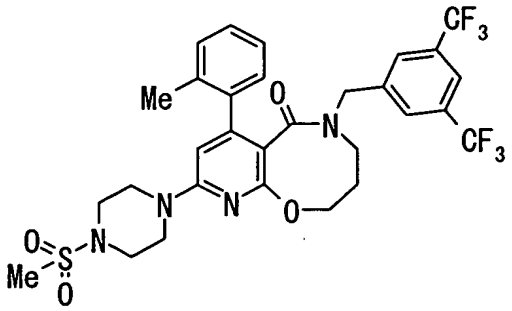


In a similar manner to Example 6, 4-[3,5-bis(trifluoromethyl)benzyl]-8-chloro-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (compound of Reference Erxample 17; 51.5mg) was reacted with 1-(t-butoxycarbonyl)homopiperazine (50.1mg) and acetyl chloride (0.1mL) to obtain 8-(4-acetylhomopiperazine-1-yl)-4-[3,5-bis(trifluoromethyl)benzyl]-6-(2-methylphenyl)-5-oxo-2,3,4,5-tetrahydropyrido[3,2-f][1,4]oxazepine (6.7mg, 11%).

MS(EI)*m/z*: 620 (M^+)

HRMS(EI): Calcd for $C_{31}H_{30}F_6N_4O_3$: 620.2222; found: 620.2230

<Example 10>



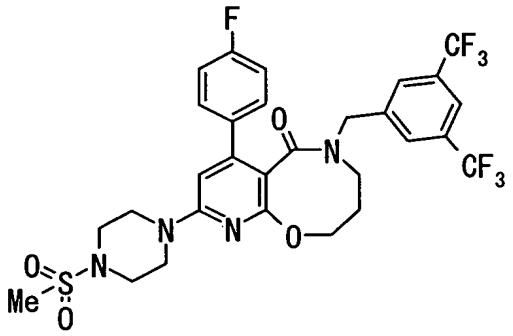
In a similar manner to Example 6, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(2-methylphenyl)-6-oxo-

2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 17; 65.0mg) was reacted with 1-(t-butoxycarbonyl)piperazine (57.5mg) and methylsulfonyl chloride (50μL) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(2-methylphenyl)-9-[4-(methylsulfonyl)piperazine-1-yl]-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (46.7mg, 58%).

MS(EI)*m/z*: 656 (M^+)

HRMS(EI): Calcd for $C_{30}H_{30}F_6N_4O_4S$: 656.1892; found: 656.1876

<Example 11>



In a similar manner to Example 6, 5-[3,5-bis(trifluoromethyl)benzyl]-9-chloro-7-(4-fluorophenyl)-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (compound of Reference Example 16; 80.0mg) was reacted with 1-(t-butoxycarbonyl)piperazine (70.0mg) and methylsulfonyl chloride (60μL) to obtain 5-[3,5-bis(trifluoromethyl)benzyl]-7-(4-fluorophenyl)-9-[4-(methylsulfonyl)piperazine-1-yl]-6-oxo-2,3,4,5-tetrahydro-6H-pyrido[2,3-b][1,5]oxazocine (23.5mg, 24%).

MS(EI)*m/z*: 660 (M^+)

HRMS(EI): Calcd for $C_{29}H_{27}F_7N_4O_4S$: 660.1641; found: 660.1633

Evidence of the effectiveness of the compounds of the present invention is provided below with reference to Test Examples.

<Test Examples>

(1) Test for NK1 receptor antagonist

The method used was according to the method proposed by S. Dion *et al.*(Dion *et al.*, Life Sciences 41(1987): 2269), to which minor modifications were made.

Guinea pigs were stunned by a blow on the head and were exsanguinated from the carotid artery and ilea were isolated. The ileum was mounted in an organ bath containing Tyrode's solution which was maintained at 32°C and gased with 95% O_2 and 5% CO_2. The ileum was subjected to a resting tension of 1-gram and allowed to equilibrate for 20 minutes before the experiment was started. As a control, a concentration-response curve for substance P in the absence of any of test compounds was used. The NK1 receptor antagonist activity of each test compound was determined by a concentration-response curve obtained by pretreating at least three concentrations of the test compound for 10 minutes and subsequently applying substance P in a cumulative manner. The Kb values were determined according to the method of Schild and the results are shown in Table 1 (Schild Brit. J. Pharmacol. 14(1959): 48).

The composition of the Tyrode's solution was as follows: NaCl = 136.9, KCl = 2.7, $CaCl_2 \cdot 2H_2O$ = 2.5, $MgCl_2 \cdot 6H_2O$ = 1.0, $NaH_2PO_4 \cdot 2H_2O$ = 0.4, $NaHCO_3$ = 11.9, glucose = 11.1(mmol/L)

Table 1

Example No.	Kb(nmol/L)
1	0.0888
2	0.0847
6	0.294
TAK-637*	0.269

* Compound described in Example 18 in Japanese Patent Laid-Open Publication No. Hei 9-263585

As can be seen from the results of Table 1, the compounds (1) or salts thereof prove to be effective NK1 receptor antagonists.

(2) Cystometry test on guinea pigs

The method used was according to the method proposed by JS. Peterson *et al.*(Peterson JS. *et al.*, J. Pharmacol. Methods 21(1989): 231), to which minor modifications were made.

Guinea pigs were anesthetized with halothane and the tenth thoracic spinal cord was cut in each animal. Subsequently, both ureters were ligated and were cut on the kidney-side. Polyethylene catheters were inserted into the bladder to provide an injection pathway for physiological saline and a pathway for the measurement of intravesical

pressure. Each animal was restricted in a Ballman cage and was left for more than 2 hours. Subsequently, room-temperature saline was injected through the bladder catheter into the bladder at a rate of 6mL/hr to conduct a cystometry test. Once the effective bladder capacity was stabilized, a test compound was intravenously administered into the jugular vein. The effective bladder capacity is defined as the volume of saline injected from one urination to the next. The effect of each test compound was determined as the increase in the average bladder volume, which was determined based on the average bladder volume measured 30 minutes prior to the administration of the test compound and the average bladder volume measured every 30 minutes after the administration of the test compound. The results are shown in Table 2.

Table 2

Test compounds	Dose (i.v.) mg/kg	Increase in bladder capacity (%)
Compound of Example 1	0.3	32.2
TAK-637*	0.3	12.0
	1	23.8
	3	20.5

* Compound described in Example 18 in Japanese Patent Laid-Open Publication No. Hei 9-263585

As can be inferred from the results of Table 2, the

compounds (1) or salts thereof have a better ability to increase the effective bladder capacity than TAK-637 in terms of the potency as well as the maximum effects.

INDUSTRIAL APPLICABILITY

As set forth, the present invention has been devised based on the discovery that the novel fused bicyclic pyridine derivatives and salts thereof act as effective tachykinin receptor antagonists.

In particular, not only have the compounds of the present invention have proven to act as NK1 receptor antagonists, but they have also been shown, by the Test Examples above, to have better effects than the conventional compounds.

Specifically, the compounds of the present invention proved to exhibit significantly higher pharmacological effects as compared to TAK-637, a known compound, when tested for their effects on dysuria, a tachykinin-mediated disorder, by cystometry, during which the ability of each of the compounds to increase the effective bladder capacity was determined in guinea pigs with broken spinal cords. In brief, the compounds of the present invention exhibited pharmacological effects comparable to the conventional TAK-637 compound at smaller doses. When compared at the same doses, the compounds of the present invention brought about significantly better pharmacological effects and elicited higher maximum effects

than TAK-637.

In addition, the compounds of the present invention and salts thereof exhibit little toxicity and are thus proven to be highly safe. Accordingly, the compounds of the present invention and salts thereof, which are effective tachykinin antagonists, are of significant usefulness in the treatment of various pathological conditions including pollakiuria.